GA1.13: RCED-90-70BR

GAO

United States General Accounting Office

Briefing Report to the Honorable Marilyn Lloyd, House of Representatives

COMPLETED
15

December 1989

# URANIUM ENRICHMENT

## U.S. Imports of Soviet Enriched Uranium

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-237747

December 8, 1989

The Honorable Marilyn Lloyd
House of Representatives

Dear Mrs. Lloyd:

On April 12, 1989, you asked us to address several issues concerning U.S. utilities' use of Soviet uranium ore and uranium enrichment services.[1] Specifically, you asked that we determine the

-- amount of Soviet uranium ore and enriched uranium imported into the United States and the extent to which utilities "flag swap" to disguise these purchases;[2]

-- U.S.S.R.'s enriched uranium trading practices;

-- need for utilities to return spent (used) fuel to the U.S.S.R. as part of the enriched uranium sales agreement;

-- U.S. import requirements applicable to uranium and enriched uranium; and

-- reasons that U.S. utilities have terminated their contracts to purchase enrichment services from the Department of Energy (DOE).

In summary, we found the following:

-- Since 1977, no Soviet uranium ore and a relatively small amount of uranium enriched in the Soviet Union has been imported directly into the United States. However, increased Soviet enriched uranium sales in the European market have lowered enrichment prices and have probably

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[1]Uranium enrichment is the process that separates natural uranium into two components, including one with a higher content of fissionable material.

[2]Many people define flag swapping as the exchange of "flags" showing the origin of certain homogeneous material, such as enriched uranium, for logistical or transportation purposes. Countries active in the nuclear fuel market, including the United States, establish their own conditions for a flag swap. See section 2 for a detailed discussion of this practice.

stimulated U.S. purchases of other foreign enrichment services. Further, DOE officials believe that nuclear fuel brokers are substituting Soviet enriched uranium for other foreign-produced material before it is imported into the United States. No mechanism exists to track these transactions. DOE estimates of lost enrichment sales to the U.S.S.R. (about $170 million between 1986 and 1988 and $90 million in 1989) assume that all foreign enrichment purchases by domestic utilities resulted from Soviet sales. DOE's Energy Information Administration (EIA) visited several U.S. utilities and fuel fabricators (companies that process enriched uranium into fuel for reactors) who have imported foreign enriched uranium within the past 2 years and found no evidence that U.S. utilities used "flag swapping" to conceal purchases of Soviet enriched uranium.

-- According to DOE officials, the U.S.S.R. does not publicize its uranium and/or enriched uranium trading or pricing policies. For many years, DOE has assumed that the U.S.S.R. could sell up to 3 million separative work units (SWU)[3] annually to Western customers. However, at a recent international conference, a Soviet official indicated that his country may have much more enrichment capacity than originally thought, and DOE market experts believe that the U.S.S.R. is willing to sell significantly more than 3 million SWU annually because of recent cutbacks in the Soviet commercial nuclear industry, reduced military requirements, and the need to obtain currency.

-- The Nuclear Regulatory Commission (NRC) licenses the export of spent fuel. According to NRC staff, the U.S.S.R. requires Eastern Bloc countries and Finland to return spent fuel but does not place such a requirement on its international sales. NRC staff also told us that no domestic utility has shipped spent fuel to the Soviet Union.

-- Any nuclear utility or fuel fabricator may import enriched uranium without obtaining a license. The importer must inform DOE and NRC by filing a Nuclear Material Transaction Report (DOE/NRC Form 741). However, this form does not identify inventory substitutions that may take place in the international market.

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[3]A separative work unit (SWU) is a measure of the effort required to separate uranium into two components, including one containing a greater amount of fissionable material.

-- Utilities that recently cancelled their contracts to purchase DOE enriched uranium say they did so because (1) they lack confidence in DOE's ability to supply enrichment services at competitive prices in the future, (2) an excess supply of enriched uranium at cheap prices is projected to be available through the year 2000, and (3) public utility commissions require them to obtain fuel at the best price to reduce electricity rates.

To obtain this information, we contacted DOE uranium enrichment program officials and NRC staff who collect data on nuclear foreign trade transactions. In addition, we spoke to officials from six utilities and four nuclear fuel brokerage firms to obtain their views on enriched uranium trade issues. We also reviewed related documents, testimonies, and studies. Our objectives, scope, and methodology are discussed in detail in section 1. Section 2 contains detailed information responding to your request.

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We discussed the facts in this report with NRC and DOE officials and incorporated their views where appropriate. As requested, we did not ask the agencies to review and comment officially on this report. Our review was conducted between April 1989 and November 1989 in accordance with generally accepted government auditing standards.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Secretary of Energy; the Chairman, NRC; and the Director, Office of Management and Budget. We will also make copies available to others upon request. If you have further questions, please contact me at (202) 275-1441.

Major contributors to this report are listed in appendix I.

Sincerely yours,

Victor S. Rezendes
Director, Energy Issues

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## ABBREVIATIONS

| | |
|---|---|
| DOE | Department of Energy |
| EIA | Energy Information Administration |
| GAO | General Accounting Office |
| NRC | Nuclear Regulatory Commission |
| SWU | separative work unit |

## SECTION 1

## OBJECTIVES, SCOPE, AND METHODOLOGY

On April 12, 1989, Representative Marilyn Lloyd asked us to address several issues concerning domestic utilities' purchases of uranium and enrichment services from the U.S.S.R.[1] Specifically, we were asked to determine the

-- amount of Soviet uranium ore and enriched uranium imported into the United States and the extent to which utilities "flag swap" to disguise these purchases;[2]

-- U.S.S.R.'s enriched uranium trading practices;

-- need for utilities to return spent (used) fuel to the U.S.S.R. as part of the enriched uranium sales agreement;

-- U.S. import requirements applicable to uranium or enriched uranium; and

-- reasons that U.S. utilities have terminated their purchase contracts with the Department of Energy (DOE).

To obtain information on the amount of uranium and enriched uranium entering the United States, we contacted officials within the Nuclear Regulatory Commission's (NRC) Office of Nuclear Material Safety and Safeguards, who help maintain the joint DOE/NRC Nuclear Materials Management and Safeguards Systems--a data base containing information on all nuclear transactions, including imports. NRC provided us data on Soviet enriched uranium imports since 1977 and information on spent fuel exports from the United States.

We also contacted the DOE Energy Information Administration's (EIA) Office of Coal, Nuclear, Electric, and Alternate Fuels, which annually collects data from the private sector on the U.S. uranium market, including foreign imports. For detailed information on foreign uranium imports, we reviewed EIA's report, Uranium Industry Annual 1988. We also obtained an August 1989 EIA report on Soviet uranium imports. EIA conducted the study to respond to questions from the Senate Committee on Energy and Natural Resources. During the study, EIA compiled and evaluated available sources of

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[1]Uranium enrichment is the process that separates natural uranium into two components, including one with a higher con ent of fissionable material.

[2]See section 2 of this report for a detailed definition of flag swapping.

information on Soviet imports of uranium and enriched uranium since 1986. It also visited two utilities, two fuel fabricators (companies that process enriched uranium into fuel for reactors), and one uranium brokerage firm to obtain documents verifying the source of foreign enrichment services and determine if enriched uranium had been "flag swapped." Because the EIA report contains proprietary data, we cannot provide the results in their entirety in this report.

To obtain information on enriched uranium marketing activities and DOE's estimate of lost sales, we contacted officials within DOE's Office of Uranium Enrichment. We also reviewed related documents, such as testimony by DOE's Deputy Assistant Secretary for Uranium Enrichment before the Senate Committee on Energy and Natural Resources on May 11, 1989. In addition, we met with an international energy specialist within DOE's Office of International Research and Development Policy to obtain information on DOE's policy on Soviet separative work unit (SWU)[3] imports. Because of the nature of this work, we did not assess either DOE's or NRC's internal controls.

We also contacted high-level officials in four U.S. companies active in the international uranium market: NUKEM, Inc.; New York Nuclear Corporation; Uranium Exchange, Inc.; and NUEXCO Information Services Company, a subsidiary of NUEXCO International Corporation, a large uranium broker and market information exchange company. These officials provided us with their views on the uranium market, related U.S. trade policy, and the impact of increased imports of Soviet enrichment services on the U.S. market.

For an overview of nuclear utilities' use of foreign enriched uranium, we met with an official of the Edison Electric Institute, an organization whose membership includes most of the 54 domestic nuclear utilities. We also contacted the nuclear fuel managers of six utilities that recently cancelled all or part of their future commitments to buy DOE enrichment services. The 6 utilities--Arizona Public Service Company, Carolina Power and Light Company, Public Service Electric and Gas Company, Niagara Mohawk Power Corporation, Northern States Power Company, and Systems Energy Resources, Inc.--own 17 nuclear power plants and annually purchase over 1 million SWU from DOE. In April 1988, these utilities cancelled their 1999 commitments to purchase over 1.4 million SWU (valued at about $140 million) from DOE.

We discussed the facts presented in this report with officials in DOE's Office of Uranium Enrichment and EIA, and NRC's Office of Nuclear Material Safety and Safeguards. They generally agreed with

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[3]A separative work unit (SWU) is a measure of the effort required to separate uranium into two components, including one containing a greater amount of fissionable material.

the facts but offered some clarifications that were incorporated where appropriate. As requested, we did not ask DOE or NRC to review and comment officially on this report. We conducted our work between April 1989 and November 1989 in accordance with generally accepted government auditing standards.

## SECTION 2

## INFORMATION ON SOVIET URANIUM AND ENRICHMENT ISSUES

The following section addresses the five issues concerning U.S. utilities' use of Soviet uranium and enriched uranium.

### U.S. UTILITIES' PURCHASES OF SOVIET URANIUM ORE AND ENRICHED URANIUM AND THEIR USE OF FLAG SWAPPING

-- According to EIA reports, no Soviet uranium ore was directly imported into the United States between 1986 and 1988. During this same period, EIA found that a total of about 6.7 million pounds (about 1.9 million SWU) of enriched uranium was imported into the United States and shipped to U.S. utilities. By comparison, DOE delivered about 16 million SWU to domestic commercial customers during the same period.

-- Between 1986 and 1988, imports represented about 12 percent of DOE deliveries to the U.S. market. Less than 10 percent of the foreign enriched uranium delivered to utilities came from the U.S.S.R. In addition, an NRC review of data contained in the Nuclear Materials Management and Safeguards Systems, an information system that receives reports on all nuclear fuel transactions, indicated that U.S. utilities and fabricators imported relatively small quantities of Soviet enriched uranium (a total of about 200,000 SWU) between 1977 and 1989.

-- DOE uranium enrichment officials do not believe that the NRC or EIA statistics truly reflect the impact of Soviet enriched uranium transactions. They say that customer, publicly available, and classified information has convinced them that nuclear fuel brokers are arranging for Soviet enriched uranium to be shipped to European suppliers, who then ship their enriched uranium to the United States. These kinds of transactions would not be reported to EIA or to the Nuclear Materials Management and Safeguards Systems.

-- Enriched uranium imported from foreign suppliers is shipped directly to nuclear fuel fabricators, who then send the processed uranium to domestic utilities or export it to foreign customers. About 40 percent of the Soviet enriched uranium directly entering this country between 1986 and 1988 was reexported to foreign customers.

-- The four uranium brokerage firms that we contacted said they had not arranged for any direct purchases of Soviet uranium or enriched uranium by a U.S. utility. However, most stated that the Soviets have been very reliable suppliers for many years in Europe, and they would arrange domestic utility purchases from the Soviets if the opportunity arose. In fact, in October 1989 NUEXCO concluded agreements with the U.S.S.R. and two U.S. fuel fabricators to import about 800,000 SWU this year. The enriched uranium will be placed in the fabricators' inventories until sold.

-- The lack of direct Soviet sales to domestic utilities does not mean that DOE's revenues have not been affected by Soviet sales. DOE's market experts say that the U.S.S.R. has become very aggressive in the short-term international market, offering SWU for $60 to $65--about half of DOE's current price. EIA officials told us that this activity has probably freed up other foreign enriched uranium inventories for sale to U.S. utilities even if deliberate substitutions have not been made. Although no system exists to track these sales, DOE's estimates of lost sales to the U.S.S.R. ($170 million between 1986 and 1988, and $90 million in 1989) assume that all foreign imports of enriched uranium to U.S. utilities resulted from Soviet sales.

-- The U.S. State Department defines a flag swap as a transaction in which the obligations pertaining to one quantity of nuclear fuel situated in one country are exchanged with those pertaining to an equivalent quantity of nuclear fuel in another country. Obligations, sometimes known as flags, are conditions placed on the use of certain nuclear material by bilateral nuclear agreements or other government regulations. For example, for nonproliferation purposes the United States prohibits domestic firms from exporting nuclear material to countries that do not have a nuclear cooperation agreement with this country. Each country active in the nuclear fuel market defines the conditions that must be met before flag swaps can occur. However, many people refer to any exchange of nuclear fuel material for logistical or transportation purposes as a flag swap. DOE uranium enrichment officials and the Secretary of Energy have alleged that utilities or their brokers arrange such exchanges to avoid direct purchases of Soviet enrichment services.

-- According to EIA officials, the country that provides enrichment services is easily determined because of required documentation on shipping manifests that accompany the canister in transport. Further, they said it would be difficult to conceal or disguise the source of enrichment

services because of the number of business entities typically involved in these transactions. However, as noted earlier, substitutions of Soviet SWU for European-produced SWU, would not be identified on existing reporting documents. EIA recently reviewed shipping documents from several nuclear utilities that had purchased foreign enriched uranium and visited two utilities, two fuel fabricators, and a uranium broker. EIA did not find any information to indicate that the utilities used flag-swapping to conceal Soviet enriched uranium imports.

-- According to the Edison Electric Institute and nuclear utility officials whom we contacted, many utilities would not purchase Soviet enriched uranium because of the negative publicity that could be associated with such purchases. Some utilities will not consider buying Soviet enriched uranium, and at least one utility includes language in its purchase contracts prohibiting its suppliers from sending it Soviet enriched uranium. However, utility officials also told us that they have a responsibility to their customers to keep costs down, and public utility commissions are encouraging them to purchase fuel from the cheapest reliable source to reduce electricity rates.

THE U.S.S.R.'S TRADING PRACTICES

-- According to DOE, the U.S.S.R. does not publicize its uranium or enriched uranium trading or pricing policies. However, at a September 1989 Uranium Institute conference in London, a Soviet official indicated that his country will try to increase its international enrichment sales. He also indicated that his country operates "several" centrifuge enrichment plants and may dedicate one solely for foreign production.

-- The U.S.S.R. is apparently increasing its efforts to sell enriched uranium to Western customers because of its need for currency and changes within its commercial and defense industries. For many years, DOE has assumed that the U.S.S.R. could sell about 3 million SWU annually to Western customers. However, because of a reported slowdown in the Soviet commercial nuclear industry and reduced military demands, market experts believe the U.S.S.R. is willing to sell significantly more than this amount. DOE now uses both 3 million and 9 million SWU to project the impact of Soviet sales in the U.S. market.

-- DOE reports that the U.S.S.R. has offered to sell enriched uranium to U.S. customers for $60 to $65 per SWU on the short-term market. (DOE's current base price is $118 per SWU.) According to one nuclear fuel broker with whom we

spoke, the U.S.S.R. would like to sign longer-term, higher-price contracts with Western customers.

-- According to a Soviet official at the London conference, in 1988 the U.S.S.R. began to offer Western customers both uranium ore and enrichment services for one price. By contrast, DOE requires utilities to supply uranium ore before enrichment takes place.

RETURN OF SPENT FUEL

-- According to NRC staff, the U.S.S.R. requires Eastern Bloc countries and Finland to return spent fuel. However, when the U.S.S.R. sells enriched uranium on the international market it does not place this requirement on the purchaser.

-- If a U.S. utility was to export spent fuel, it would need to obtain an export license from NRC. According to NRC, only a very small amount of spent fuel has been exported to Western European laboratories for research purposes under cooperative agreements between the United States and the countries involved. No such agreement exists between the United States and the U.S.S.R. NRC staff told us that no U.S. utility has exported spent fuel to the U.S.S.R.

FEDERAL REQUIREMENTS
REGARDING URANIUM IMPORTS

-- Almost all imports of nuclear-related material may take place under the NRC's general import licensing authority. This means that a utility or fuel fabricator may import uranium or enriched uranium without obtaining a specific license from NRC. One exception is uranium ore or ore oxide (commonly called yellow cake) from South Africa, which cannot be licensed for import into the United States under the Comprehensive Anti-Apartheid Act of 1986.

-- Although the importer is not required to obtain a license, it must comply with all applicable NRC rules, regulations, and orders regarding the transportation and handling of uranium or enriched uranium. In addition, the importer must file a Nuclear Material Transaction Report (DOE/NRC Form 741), which becomes part of the Nuclear Materials Management and Safeguards Systems. The form requires information on the transaction, including country of origin. DOE and NRC rely on the honesty of the importers to provide accurate information. However, the form does not identify the substitution of Soviet enriched uranium for European-produced material.

UTILITIES' LONG-RANGE
PURCHASE PLANS

-- DOE's uranium enrichment contracts allow utilities to cancel their future DOE purchase commitments if they notify DOE 10 years in advance of the cancellations. As of April 1989, 17 utilities (operating about 40 plants) had elected to cancel their commitment to purchase all or part of their enriched uranium from DOE after 1996. DOE estimates that these cancellations represent about 6.9 million SWU (about $810 million) or about 27 percent of DOE's expected sales from 1996 to 1999.

-- All domestic nuclear utilities, including those who have cancelled their DOE commitments, have not contracted for about 55 percent of their expected SWU needs (about 25 million SWU) between 1996 and 2000. This represents the world's largest block of uncommitted demand for enriched uranium in the near future. Thus, foreign suppliers with excess capacity are expected to concentrate their sales efforts on the U.S. market.

-- On the basis of information provided by the Edison Electric Institute, six nuclear utilities, and the testimony of four other nuclear utilities before the Senate Committee on Energy and Natural Resources and the House Subcommittee on Energy Research and Development, Committee on Science, Space, and Technology, utilities have cancelled their long-term commitments with DOE for the following reasons:

  - Excess enrichment capacity is expected to exist throughout the world through the year 2000. For example, EIA estimates that enrichment capacity will be over 40 million SWU in the year 2000 while reactor demand will be less than 30 million SWU. Therefore, utilities can defer long-term purchase contracts with DOE in hopes of finding bargain prices later.

  - Public utility commissions are encouraging utilities to purchase fuel at the best price to reduce electricity rates.

  - Because of increasing environmental and decommissioning costs and other unresolved problems, DOE may not be able to offer competitive prices in the future.

-- Several utility executives who cancelled their DOE commitments said that they may still buy from DOE in the 1990s--but they do not need to commit for long-term purchases, given projected market conditions.

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